

UNIT 8 – THE ENDOCRINE AND LYMPHATIC SYSTEMS

Pleasant Valley High School
Anatomy and Physiology

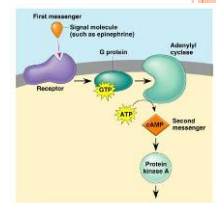
THE ENDOCRINE SYSTEM

ENDOCRINE SYSTEM

- Second great controlling system of the body
- Endocrine glands produce and secrete hormones
 - Hormones – chemical messengers that act on target cells to affect cellular metabolism
 - Three Types
 - Amino Acid based molecules – proteins, peptides
 - Steroids – made from cholesterol
 - Prostaglandins – lipid based

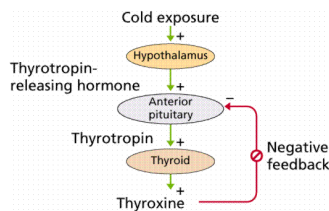
ENDOCRINE MECHANISM

- Direct Gene Activation
 - Steroids activate certain genes to synthesize new proteins
- Second Messenger System
 - Non-steroid hormones use enzyme cascades to change cell response



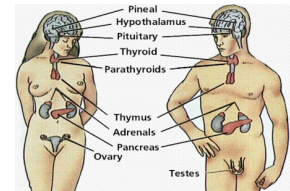
CONTROL MECHANISM

- Negative Feedback Mechanism
 - Hormone secretion triggered and then rising levels of the hormone inhibits further release



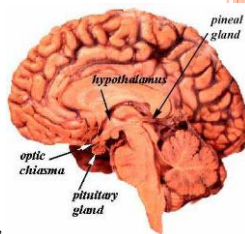
MAJOR ORGANS OF THE ENDOCRINE SYSTEM

- Pituitary Gland
- Thyroid Gland
- Parathyroid Gland
- Adrenal Gland
- Pineal Gland
- Thymus Gland
- Pancreas
- Gonads
 - Ovaries
 - Testes
- Hypothalamus



PITUITARY GLAND

- Size of a pea
- Hangs from the hypothalamus
- Two functional lobes
 - Anterior Pituitary
 - Posterior Pituitary
- Often called the “master gland”
- It is controlled by the hypothalamus



ANTERIOR PITUITARY HORMONES

- Growth Hormone (GH) – directly tied to growth of skeletal muscles and long bones
- Prolactin (PRL) – stimulates milk production, helps in formation of oligodendrocytes
- Adrenocorticotrophic Hormone (ACTH) – regulates adrenal cortex, stimulates production of cortisol (the stress hormone)
- Thyroid Stimulating Hormone (TSH) / Thyrotropic Hormone (TH) – influences Thyroid hormone
- Gonadotropic Hormones
 - Follicle Stimulating Hormone (FSH) – stimulates follicle development in ovaries
 - Lutenizing Hormones (LH) – Triggers ovulation of egg in females, in men, it stimulates testosterone production

PROBLEMS WITH THE PITUITARY?

- Can lead to dwarfism or giantism

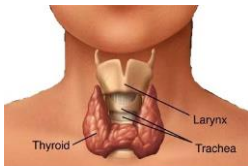


POSTERIOR PITUITARY HORMONES

- Oxytocin – released during childbirth and in nursing women, also during the healing of wounds
 - Stimulates contractions (positive feedback)
 - Causes milk ejection
- Antidiuretic Hormone (ADH) –
 - Inhibits urine production
 - Causes Kidneys to absorb more water

THE THYROID GLAND

- Located at the base of the throat just inferior to the Adam's apple
- Produces thyroid hormone and calcitonin (the body's ability to break down food)



THYROID HORMONES

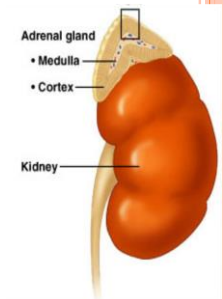
- Thyroxine (T4) and Triiodothyronine (T3)
 - Controls rate at which glucose is burned and converted into body heat and chemical energy
 - If no iodine in diet, no TSH is being made, there is no negative feedback mechanism for T3 and as a result, the thyroid grown out of control (goiter)
 - Iodine is found only in seafood, but is added to salt (iodized salt)
- Calcitonin
 - Lowers Calcium ion concentration
 - Causes the calcium to deposit into the bones

PARATHYROID GLANDS

- Small masses on the thyroid gland
- Secrete Parathyroid Hormone (PTH)
 - Regulates Calcium ion concentration
 - Stimulates osteoclasts to break down bones to release calcium

ADRENAL GLANDS

- Superior to the kidneys
- Made of glandular (cortex) and neural (medulla) tissue
- Hormones
 - Mineral Corticoids
 - Main – aldosterone, regulates salt levels in the blood
 - Glucocorticoids
 - Main – cortisone and cortisol, promotes metabolism, resists long term stressors by increasing glucose levels
 - Sex Hormones
 - Main – androgen, also makes estrogen



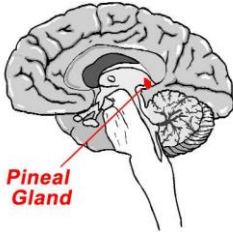
PANCREAS

- Located close to stomach in the abdominal cavity
- Structures called *Islets of Langerhans* secrete:
 - Insulin – targets all body cells to increase glucose breakdown and reduces blood sugar levels
 - Glucagon – regulates blood glucose levels by targeting liver to break down stored sugar, increases blood sugar
 - If insulin production is not at needed levels, glucagon increases the blood sugar level to unhealthy levels and results in diabetes

- Diabetes Mellitus
 - Results from insulin deficiency
 - Blood sugar rises (hyperglycemia) and excess is excreted in urine
 - Type I – insulin dependent
 - Caused by inherited disorder that destroys the islets and patient must take insulin supplement
 - Type II – mature onset
 - Can be controlled with diet and exercise

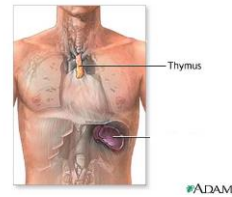
PINEAL GLAND

- Very small, mysterious gland that hangs from the inner brain
- Secretes Melatonin (plays a role in maintaining circadian rhythms – sleep cycles)



THYMUS GLAND

- Located in the upper thorax, posterior to the sternum
- Produces Thymosin (aids in the development of WBC)



GONADS

- Ovaries
 - Female gonads, paired, located inside the pelvic cavity, produce ova
 - Produce estrogens and progesterone
 - Estrogen – displays female sex characteristics
 - Progesterone – responsible for the menstrual cycle
- Testes
 - Male gonads, paired, located externally in the scrotum, produce sperm
 - Produce androgens (namely: testosterone)
 - Determine sex characteristics in men
 - Initiate sperm production

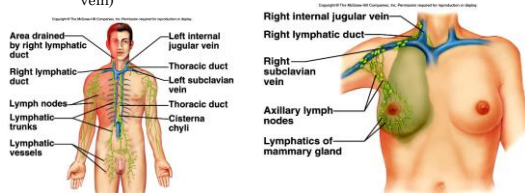
- [Hormone Rap Video](#)

THE LYMPHATIC SYSTEM AND IMMUNITY

INTRODUCTION

- The lymphatic system is comprised of a network of vessels that transport body fluids, the cells and chemicals in those vessels, and the organs and glands that produce those chemicals and cells
- Lymphatic vessels carry and collect excess fluids from interstitial spaces and special vessels called *lacteals*
- The organs of the lymphatic system help defend against disease
- Lymphatic Vessels
 - Walls are thinner than circulatory veins but are constructed the same way
 - Larger lymphatic vessels pass through lymph nodes and merge to form lymphatic trunks

- Lymphatic trunks
 - Trunks drain lymph from the body and are named for the regions in which they drain
 - The trunks join one of two collecting ducts
 - Either thoracic duct (drains into the left subclavian vein) or right lymphatic duct (drains into the right subclavian vein)



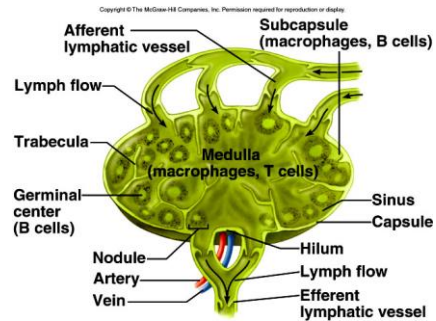
TISSUE FLUID AND LYMPH

- Tissue fluid becomes lymph once it has entered a lymphatic capillary (a closed ended tube), lymph formation depends on tissue fluid formation
- Tissue Fluid Formation
 - Tissue fluid is made of water and dissolved substances that leave blood capillaries by filtration and diffusion
 - During filtration, some small proteins leak from capillaries into the tissues and are not returned to the bloodstream. Thus increasing the osmotic pressure in the tissues

LYMPH NODES

- Lymph nodes contain *lymphocytes* and *macrophages* and are located along lymphatic pathways
- Structure of a Lymph Node
 - Bean shaped with blood vessels, nerves, and efferent lymphatic vessels attached to an indented *hilum*, and with afferent lymphatic vessels entering on a convex surface
 - Covered with connective tissue that extend inside the node and divides into *nodules* and *sinuses*
 - The lymphocytes and macrophages clean the lymph as it flows through the lymph node

ANATOMY OF A LYMPH NODE

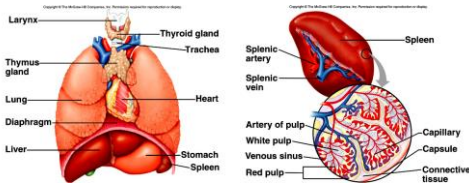


LOCATION AND FUNCTION OF A LYMPH NODE

- Location
 - Generally found in chains along the parts of the larger lymphatic vessels, found throughout the body with the exception of the CNS. See Figure 14.8
- Function
 - Macrophages and lymphocytes within the nodes filter lymph and remove bacteria and cellular debris before lymph is returned to the bloodstream
 - Nodes are also the center of lymphocyte production...these cells are crucial in immune surveillance

THYMUS AND SPLEEN

- These two organs function similarly to the nodes
- Thymus
 - Soft, bi-lobed organ found behind the sternum, shrinks as a person matures (large in children, not visible by the naked eye in adults), surrounded by CT
 - The lobes contain lymphocytes (some mature into T Lymphocytes or *T cells*),
 - Secretes the hormone *thymosin*, which influences the maturation of T cells
- Spleen
 - In the upper left abdominal cavity, the largest lymphatic organ
 - Resembles a large lymph node, but contains blood instead of lymph
 - Contains *white pulp* and *red pulp*
 - Spleen filters blood and removes damaged blood cells and bacteria



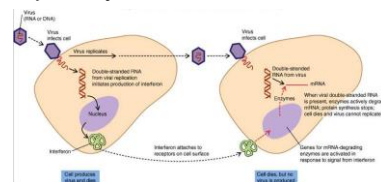
D...DE...DEFENSE

- Disease causing agents called *pathogens* can produce infections in the body. Can be viruses, bacteria, fungi, protozoans, etc.
- The body has two lines of defense
 - First Team: *Nonspecific Defense*
 - Guard against any pathogen
 - Macrophages and lymphocytes work together to destroy any foreign invader
 - Second Team: *Specific Defense*
 - Mount a response against a very specific target
 - Lymphocytes attack a known pathogen (immunity)

NONSPECIFIC DEFENSE

- Species Resistance
 - A species is resistant to diseases that affect other species because it has a unique chemical environment or temperature that fails to provide and adequate habitat (Example: humans get measles...not another known carrier)
- Mechanical Barriers
 - Unbroken skin and mucous membranes of the body create a *mechanical barrier* that prevent the entry of most pathogens
 - A mechanical barrier is the **first line of defense**

- Chemical barriers
 - High acidity in the stomach, lysozyme in tears
 - *Interferons* – hormone like peptides that serve as antiviral substances
 - Produced by cells after they have been infected with a specific virus, induce nearby cells to produce antiviral enzymes that protect them



○ Fever

- Interferes with the proper temperature required for an infection to grow
- Amount of iron is reduced in the blood, thus reducing amount of nutrients
- Phagocytic cells attack with more rigor when temp is up

○ Inflammation

- Redness, swelling, heat, and pain of a tissue in response to pathogen
- Dilatation of blood vessels → increase in volume of blood → invasion of WBCs → appearance of fibroblasts and the production of a protective sac around the infected area

○ Phagocytosis

- *Neutrophils* and *monocytes* are the two most active phagocytes
- Neutrophils engulf small particles, monocytes attack larger ones breaking them apart
- Monocytes turn into macrophages in maturity
- The trio of monocytes, macrophages, and neutrophils make the *mononuclear phagocytic system*
- Phagocytosis removes foreign particles from the lymph

SPECIFIC DEFENSES (IMMUNITY)

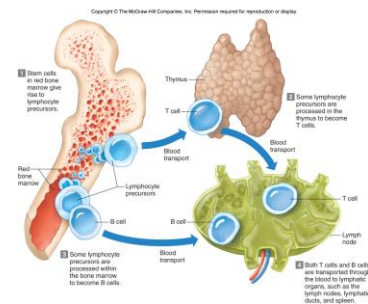
○ The **third line of defense**

○ Antigens

- Before birth, the body produces antigens as a means of self identification
- Large molecules that elicit an immune response

○ Lymphocyte Origins

- During fetal development, red bone marrow releases lymphocytes into circulation. 70-80% of those become T cells and the remainder become B cells
- These T and B cells reside in the lymphatic organs in maturity



○ Lymphocyte Functions

- T cells are offensive, they attack foreign, antigen bearing cells by direct cell-to-cell contact; *cell mediated immunity*
- T cells also secrete *cytokines* that enhance cellular response to antigens
- T cells can also secrete toxins that kill target cells or produce interferons to attack viruses
- B cells attack by differentiating into *plasma cells* that secrete antibodies
- Body fluids then attack and destroy antigens or antigen bearing particles through an antibody-mediated immunity, *humoral immune response*

○ Types of Antibodies

- 5 major types of immunoglobins
 - *IgG* – found in tissue fluid and plasma, defends against bacteria, viruses, and toxins, activates *complement*
 - *IgA* – found in exocrine gland secretions, in breast milk, tears, nasal fluid, gastric juices, intestinal juices, and bile
 - *IgM* – develops in blood plasma in response to foods or bacteria, also activates complement
 - *IgD* – on the surface of B cells, important in activating B cells
 - *IgE* – appears alongside IgA, associated with allergic reactions

○ Immune Responses

- *Primary Immune Response* – the first activation of a B or T cell, leaves some cells behind as memory cells
- *Secondary Immune Response* – if the same antigen is encountered again, more numerous memory cells can mount a rapid response
 - *This response can be life-long*

○ Classification of Immunity

- Naturally Acquired Active Immunity
 - After exposure to an antigen
- Artificially Acquired Active Immunity
 - Occurs due to vaccine without direct contact with the disease
- Naturally Acquired Passive Immunity
 - Antibodies are passed from mother to fetus – short lived
- Artificially Acquired Passive Immunity
 - Injection of gamma globulin and antibodies – short lived

○ Allergic Reactions

- Reaction to an allergen is an excessive immune response that can lead to permanent and fatal tissue damage
- A *delayed-reaction allergy* results from repeated exposure to substances that cause inflammation
- An *immediate-reaction allergy* is an inherited ability to overproduce IgE
- During an allergic reaction, mast cells release histamine and leukotrienes and produce a plethora of effects
- Allergy mediators can flood the body. Resulting in anaphylactic shock, the most severe form of allergic reaction

○ Transplantation and Tissue Rejection

- A transplant recipient's immune system may react with a foreign antigen on the surface of transplanted tissue causing the body to reject the tissue through an allergic reaction
- Close matching of donor and recipient tissue can reduce the chances of tissue rejection, and *immunosuppressive drugs* may reduce rejection, however, this leaves the patient at a greater risk of infection

AUTOIMMUNITY...CELLULAR SUICIDE

- In autoimmune disorders, the immune system manufactures antibodies against its own antigens
- Usually the result of a viral infection, faulty T cell development, or a reaction to nonself antigen that is closely related to a self antigen.